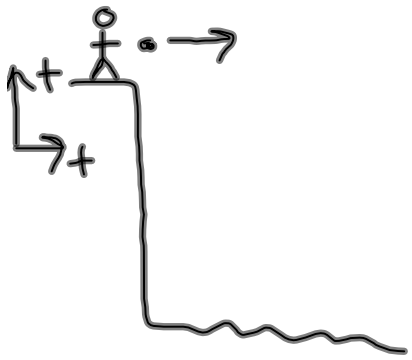
Quarter Exam Review 3.19.12 Honors Physics

A person is standing of the edge of a cliff, which is 200 m high. The person throws a stone horizontally off the cliff at 12 m/s.
a) How long does it take for the stone to reach the water below?
b) How far does it go in the x-direction?



$v_{ix} = 12\ m/s$ $\quad \Delta x = ?$

$v_{iy} = 0\ m/s$ $\quad \Delta y = -200\ m$

$a_x = 0\ m/s^2$ $\quad t = ?$

$a_g = -9.8\ m/s^2$

a) $\Delta y = v_{iy}t + \frac{1}{2}a_g t^2$

$t = \sqrt{\frac{2\Delta y}{a_g}}$

$= \sqrt{\frac{2(-200\ m)}{(-9.8\ m/s^2)}}$

$= 6.39\ s$

b) $\Delta x = v_{ix}t$

$= (12\ m/s)(6.39\ s)$

$= 76.6\ m$

Projectile Motion:

- Assumptions:

  1. Acceleration in x-direction equals zero.

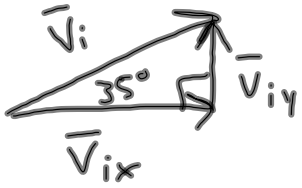
     (object does NOT change velocity in the x-direction)

  2. Free-fall in the y-direction, meaning that the only acceleration is a_g.

     (object WILL change velocity in the y-direction)

- Problem types:
  - Cliff (changing Δy)
  - Golf ball (not changing Δy → ball starts and finishes at the same height)

A golf ball is hit at a velocity of 45 m/s at an angle of 35 degrees.
a) If the golf ball goes a distance of 300 m, how long is the ball in the air?
b) How high does the ball go in the air?



$V_{ix} = V_i \cos(35°) = 36.9\ m/s$

$V_{iy} = V_i \sin(35°) = 25.8\ m/s$

a) $\Delta x = 300\ m$

$\Delta x = v_{ix} t$

$t = \frac{\Delta x}{v_{ix}} = \frac{300\ m}{36.9\ m/s} = 8.14\ s$

b) highest point occurs at $\frac{1}{2}t$

y-velocity at highest point equals zero

two equations to solve:

$\Delta y = v_{iy} t + \frac{1}{2} a_g t^2$ $\quad v_{fy}^2 = v_{iy}^2 + 2 a_g \Delta$

$= 23.9\ m$ $\quad \Delta y = 32.9\ m$

these are different because I made up the 300 m number. either will work on the test,

Impulse-Momentum theorem:

impulse = change in momentum

$$\bar{J} = \Delta \bar{p}$$

$$\bar{F}\,\Delta t = m\,\Delta \bar{v}$$

$$\bar{F}\,\Delta t = m\left(\bar{v}_f - \bar{v}_i\right)$$

A 25 N force is applied to a box for 10 s. It has a mass of 10 kg, and has an initial velocity of 4 m/s. What is the box's final velocity after the 10 s?

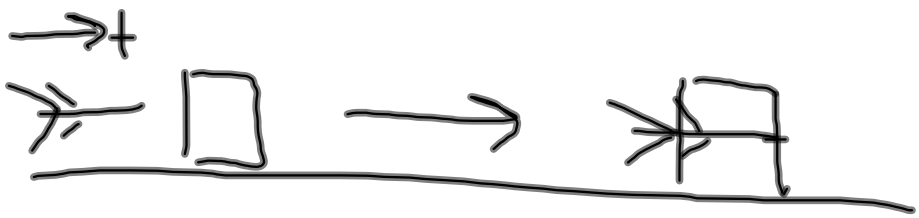
$$F\Delta t = m(v_f - v_i)$$

$$v_f = \frac{F\Delta t}{m} + v_i$$

$$= 29\ m/s$$

A dart has an initial velocity of 90 m/s and it collides and sticks in a stationary block (mass =10 kg). If they slide together at a velocity of 8 m/s, what is the mass of the dart?

Inelastic → hit-and-stick



$$m_1\bar{v}_{1i} + m_2\cancel{\bar{v}_{2i}}^{\,0} = (m_1+m_2)\bar{v}_f$$

$v_{1i} = 90\ m/s$

$v_f = 8\ m/s$

$m_2 = 10\ kg$

$$m_1 v_{1i} = m_1 v_f + m_2 v_f$$

$$m_1 v_{1i} - m_1 v_f = m_2 v_f$$

$$m_1 = \frac{m_2 v_f}{v_{1i} - v_f}$$

$$= \frac{(10\ kg)(8\ m/s)}{90\ m/s - 8\ m/s}$$

$$\approx 0.98\ kg$$

A 1.55 kg yellow sphere moving at 5.55 m/s to the right collides head-on with an 8.55 kg green sphere moving at 5.55 m/s to the left. After the collision, the green sphere is still moving to the left, but now with a speed of 3.25 m/s. What will the yellow sphere's velocity be after the collision?

$\rightarrow +$

$m_Y = 1.55\ kg$ $\quad v_{Yf} = ?$ $\quad v_{Gf} = -3.25\ m/s$

$v_{Yi} = +5.55\ m/s$ $\quad v_{Gi} = -5.55\ m/s$ $\quad m_G = 8.55\ kg$

Elastic $\rightarrow$ hit-and-bounce

$$m_Y \bar{V}_{Yi} + m_G \bar{V}_{Gi} = m_Y \bar{V}_{Yf} + m_G \bar{V}_{Gf}$$

$$V_{Yf} = \frac{1}{m_Y}\left[m_Y \vec{V}_{Yi} + m_G \bar{V}_{Gi} - m_G \bar{V}_{Gf}\right]$$

$$= -7.14\ m/s$$